MICROPROCESSORS

Advising Prof. Dr. Jens – Peter Kaps

A report on

ALARM CLOCK

Using MSP430 Launchpad

BY

PRAVALIKA REDDY (G00845445)
ANISH CHANDRA GORTHI (G00830622)
RAVI CHANDRA REDDY (G00855112)
# TABLE OF CONTENTS

1. INTRODUCTION

2. BLOCK DIAGRAM AND HARDWARE COMPONENTS
   2.1 BLOCK DIAGRAM
   2.2 MSP 430
   2.3 SEVEN SEGMENT DISPLAY
   2.4 BUZZER
   2.5 LED
   2.6 PUSH BUTTON

3. WORKING PRINCIPLE

4. DIVISION OF WORK AND CHALLENGES
   4.1 CHALLENGES
   4.2 SNAP SHOT OF OUR PROJECT
   4.3 DIVISION OF WORK
   4.4 COMPONENTS USED
   4.5 CONCLUSION
   4.6 REFERENCES
CHAPTER 1
INTRODUCTION

The main objective of this project is to design a new model of an alarm clock using msp430. In this alarm clock there will be flashing light and a tune will be played when the alarm is ringing.

For this project we use msp430, two push buttons are used as inputs and a buzzer is connected to a timer output to generate some tones. A resistor to pull up the reset line, clock quartz to keep track of the time and a buffer capacitor for good measure are all the additional parts needed.
CHAPTER 2

2.1 BLOCK DIAGRAM
Schematic Diagram

HARDWARE COMPONENTS

2.2 MSP 430
Launch Pad is created to provide everything you need to get started with MSP430 microcontroller development. All Launch Pad boards feature on-board emulation for programming & debugging code, push buttons & LEDs, as well as a consistent connector that accepts our Booster Pack plug-in modules, which adds new functionality to the Launch Pad such as wireless connectivity, LEDs, sensors & more. Each kit includes the Launch Pad board, USB cable & quick start guide to help you get up and running quickly.

MSP430 Launch Pad Kit

FEATURES
- MSP430G2553 at 16 MHz
- Capacitive Touch I/O
- On-board emulation
- 20 pin Booster Pack Header
- 16 KB Flash, 512 B RAM, 8ch 10-bit ADC, 2 16-bit timers
- Up to 1 I2C, 2 SPI, 1 UART

### 2.3 SEVEN SEGMENT DISPLAY

A seven-segment display (SSD), or seven-segment indicator, is a form of electronic display device for displaying decimal numerals that is an alternative to the more complex dot matrix displays. Seven-segment displays are widely used in digital clocks, electronic meters, and other electronic devices for displaying numerical information. Based on cathode and anode connections there are basically two common configurations.

Common Cathode Configuration (Cathodes are connected together)

Common Anode Configuration (Anodes are connected together).

We have used common anode as a part of this project.

![Common Anode Configuration Diagram]
2.4 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

2.5 LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for general lighting. An LED is often small in area (less than 1 mm²), and integrated optical components may be used to shape its radiation pattern.
LEDs have many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching.

2.6 PUSH BUTTON

Push buttons are used to provide input or to reset the main circuit. So usually we have to monitor a specific pin on your microcontroller which lets our program know when the button is been pressed or not.

- Button not pressed = disconnected circuit
- Button pressed = connected circuit.
CHAPTER 3

Working Principle

The clock uses a MSP430G2553 controller which comes packaged with the Launch Pad. Since the 4 digit 7 Segment display needs a total of 32 lines for control and the controller has only 14 lines, so we used multiplexing to turn on required segments. So code has been written for the below mentioned functionalities:

- Brightness adjustment
- Push button gets you through current time, alarm on/off and sleep modes
- 12H or 24H display format
- An adjustment to make the clock go faster/slower by setting a gain value
- Flash saving of setting
- Low power Mode
- Pin 19, 17 (TEST) and pin 4, 16 (RST) pairs are tied on purpose of convenience. As TEST and RST pins are for debug and programming, they serve no purpose in the circuit. Except that they lies on the same column in the breadboard layout which automatically connects them to LED pin 12 and 10 i.e. since they are shared and we did multiplexing (i.e.
rapid displaying one digit at a time). Internal VLO clock (~12 KHz) is used to keep time running even in the power down sleep mode.

CHAPTER 4

4.1 CHALLENGES

First we thought of using 4 individual seven segment displays to drive 32 LED’s and show the output clock display. MSP430G2553 has only 14 IO pins at most, so to get hold of the low pin count, we used a 74HC164 shift register for port expansion. Thus two pins of the MSP430 are used as shift register clock and data yielding eight outputs for the anodes of the seven-segment (plus decimal point). Another four pins of the MSP430 are used to time-multiplex the four common-cathode digits, using a variable time per digit depending on the LED count, the digit is using. This is done to get the digits equally bright. The remaining two pins of the MSP430 are connected to push buttons for user interaction -- one pin serving double as input and output when playing the alarm tune. But we are unsuccessful in driving the power to all the components.

Later we thought of using multiplexing to briefly turn on and off different led segments, instead of driving individual led. We do this ever so quickly to fool our eyes that the LED’s are constantly on. This we thought of implementing with 4 individual seven segment displays by connecting all commons ports through wires and getting total 12 pins out to connect to MSP430
thereby we can eliminate the shift registers. The connections involved in this type are complex. So we used 4 digit seven segment display instead, which has same internal connection as 4 individual seven segments connected together.

Thus by using 4 digit seven segment display we have eliminated use of shift registers (for port expansion) and also the complexity of connecting four individual seven segments.

4.2 **SNAP SHOT OF OUR PROJECT**
4.3 DIVISION OF WORK

HARDWARE INTERFACING: Pravalika, Anish Chandra
CODING AND INTEGRATION: Ravi Chandra Reddy K
4.4 COMPONENTS USED

MSP430 Launch Pad-1
MSP430G2553 Microcontroller-1
4 Digit Seven Segment Display-1
Push Buttons -2
Resistors (150 Ohm)-8
Buzzer -1
LED -1
Breadboard-1
Connectors

4.5 CONCLUSION

Thus an Alarm Clock has been built with minimal components and at low cost by using MSP430 launch pad.

4.6 REFERENCES

1. MSP430 Microcontroller Basics by John Davies (Author), John H. Davies (Author)